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PATENT SPECIFICATION

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(54) MILK PRODUCT

(71) We, KRAFTCO, INC., formerly Kraftco Corporation, a corporation organized under the Laws of the State of Delaware, United States of America, of Kraftco Court, City of Glenview, County of Cook, State of Illinois, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates generally to the provision of a whipped milk product which is commonly known as a milk shake. More particularly, the present invention relates to a whipped product which can be frozen and subsequently thawed to provide a product having the characteristics of a milk shake.

Milk shakes are a well known product which are made in the home or sold by the food-serving industry, which includes restaurants, ice cream parlors and fast-serve operations. The milk shake is usually made by combining milk with ice cream and a flavoring material to provide a mix and thereafter whipping the mix to provide a milk shake having some overrun.

In the food-serving industry it is relatively time consuming to prepare individual milk shakes. Moreover, milk shakes must often be prepared in advance in anticipation of peak business during certain hours of operation. It is often difficult to anticipate the correct number of milk shakes which should be prepared and wastage is incurred. In the home, preparation of milk shakes requires the setting up of equipment, scooping of ice cream, and availability of liquid milk.

It has been recognized that it would be desirable to provide milk shakes in a frozen condition which could be thawed to provide a product like that which is made by the conventional method. However, conventionally prepared milk shakes made by mixing together ice cream and milk are not suitable for freezing and subsequent thawing. Conventionally prepared milk shakes, when frozen and subsequently thawed, lose their overrun and break down into stratified layers of flavoring and milk. Various attempts have been made to provide a milk shake suitable for freezing but they have not resulted in products which are sufficiently like the conventionally prepared milk shakes upon thawing to be competitive or satisfactory to consumers.

Accordingly, the principal object of the present invention is to provide a milk shake which is suitable for whipping and freezing. It is another object of the present invention to provide a frozen milk shake which upon thawing is sufficiently like conventionally prepared milk shakes to be satisfactory to consumers. It is a further object of the present invention to provide a method for making a milk shake which is suitable for freezing and upon subsequent thawing provides a milk shake substantially similar to conventional milk shakes.

According to the invention there is provided a method for making a frozen product comprising the steps of preparing a mix containing fat, disaccharide sugar, monosaccharide sugar, a stabilizer, an emulsifier and a polyhydric alcohol freezing point depressant, said freezing poing depressant being present at a level sufficient to establish an initial freezing point in said mix of less than $-4°C$, pasteurizing said mix, homogenizing said mix, dynamically cooling said mix to a temperature of less than $-7°C$, injecting gas in said mix during said cooling step so as to whip the mix and to provide a product having from 50 to 100 percent overrun and freezing said whipped, cooled mix to provide a frozen product which upon subsequent thawing has the characteristics of milk shake.

Generally, in accordance with the present invention, a milk shake is provided from edible protein, fat, disaccharide sugar, monosaccharide sugar, stabilizer, emulsifier and a polyhydric freezing point depressant. The milk shake contains suitable flavoring materials to provide a desired flavor. Preferably, the milk shake of the invention comprises dairy ingredients selected from whole milk, skim milk, casein, sweetened condensed whole milk, con-

densed skim milk, skim milk powder, whole milk powder and cream in such proportions as required to provide fat and protein in the ranges indicated below. The disaccharide sugar and monosaccharide sugar are present in the mix at a particular ratio and at levels within the ranges indicated below. The polyhydric freezing point depressant is provided at a level sufficient to establish an initial freezing point of less than −4°C and preferably within the range of from −4°C to −17°C.

The components of the milk shake of the invention are present at levels sufficient to provide a milk shake having the ingredients indicated below in Table I within the indicated range:

TABLE 1.

Ingredient	*Weight Percent*
Protein	2.4—3.4
Fat	3.5—5.0
Disaccharide Sugar	4.0—6.0
Monosaccharide Sugar	5.0—9.0
Water	66 — 77

It is a further requirement for the milk shake of the invention that the ratio of monosaccharide sugar to disaccharide sugar in the mix be within the range of 1.2:1 to 1.6:1. When dairy ingredients provide protein and fat, they also provide the disaccharide sugar, lactose. In general, from 3 to 4 percent lactose is provided by the dairy ingredients. If further disaccharide sugar is required, it is preferred to use sucrose to provide the balance of disaccharide sugar. A preferred monosaccharide sugar is dextrose.

The preferred fat source in the milk shake of the invention is whole milk or cream. However, other fats derived from vegetable and animal sources which are incorporated in filled milks and whipped toppings can be used. In particular, partially hardened vegetable oils which have physical properties substantially similar to those of milk fat can be used.

The preferred protein source in the milk shake of the invention is whole milk, skim milk and modified whey products. However, imitation milk, containing a vegetable protein, can be used.

The polyhydric freezing point depressant is used in the milk shake of the invention to provide the milk shake with an initial freezing point of −4°C or less. During dynamic cooling of the milk shake, latent heat is removed from water in the mix and ice crystals are formed. A new freezing point is established for the remaining solution since it has become more concentrated in respect to the soluble constituents. The transfer of sensible heat from the unfrozen solution lowers the temperature to a new freezing point and more water is converted into ice. Thus, the freezing point of the liquid portion of the milk shake is continually changing as water is frozen during the freezing process. It is an important feature of the present invention that the milk shake have an initial freezing point of −4°C or less. Such initial freezing point is substantially lower than heretofore known mixes used to prepare frozen whipped desserts, such as ice cream. As explained more fully hereinafter, the temperature of the milk shake is reduced by dynamic cooling to a temperature within the range of −7°C to −14°C. This temperature range is below the temperature normally associated with dynamic cooling of ice cream mixes and other frozen comestible mixes. The use of the polyhydric freezing point depressant in the milk shake of the present invention permits use of such lower temperatures and provides a semi-frozen mix with desired level of overrun upon exit from a heat exchanger used for dynamic cooling. Upon subsequnt further cooling of the semi-frozen mix a desirable crystal size, texture and mouth feel are imparted to the milk shake.

Suitable polyhydric freezing point depressants are glycerol and propylene glycol. A particularly preferred polyhydric freezing point depressant for reasons of flavor is glycerol. As indicated, the polyhydric freezing point depressant is used at a level sufficient to provide a milk shake having an initial freezing point of −4°C or less, preferably within the range of −4°C and −17°C. In general, the freezing point depressant is used in the milk shake mix at a level of from 6 to 9 percent by weight of the mix to provide the desired initial freezing point.

The use of a polyhydric freezing point depressant in accordance with the invention in combination with the use of lower dynamic cooling temperatures greatly enhances the stability of the milk shake of the invention. Stability is an expression of the ability of a fat-water emulsion, such as the milk shake of the invention, to resist the de-emulsifying effect of whipping and freezing. Stability depends not only on a balance of ingredients, but on their state of dispersion and interaction.

Due to the high level of moisture and low level of fat in a milk shake, the foamed milk shake is inherently unstable. In accordance with the present invention, it has been found that the interaction of the polyhydric freezing point depressant with selected stabilizers and emulsifiers provides the milk shake of the invention with sufficient stability to withstand the whipping-freezing-thawing cycle and provide a milk shake with the desirable foam, texture and body characteristics associated with conventional milk shakes. Stability is dependent on emulsion (water-fat) stability, colloid (protein-gum stabilizer) and the interaction between the emulsion and the colloid.

The milk shake mix is homogenized so as

to reduce the fat to a fine degree of subdivision and a high degree of dispersion. This results in providing a greatly expanded fat surface. The globules in the homogenized mlik shake are surrounded by an interfacial layer of protein which is complexed with the stabilizing agents used in the invention.

It should be understood that the milk shake of the present invention is a very high moisture, low fat product compared to frozen dessert products which have been heretofore known. While not wishing to be bound by any theory, it is believed that the stability of the milk shake is related both to the presence of the polyhydric freezing point depressant, the stabilizer and the emulsifier, and to the particular method for manufacture of the frozen milk shake, wherein lower than usual dynamic cooling temperatures are used.

The stabilizing agents useful in the present invention are any of the gums normally associated with the manufacture of ice cream. Such gums include carboxymethylcellulose (CMC) in the sodium salt form, carrageenan, sodium alginate, propylene glycol alginates, locust bean gum and guar gum. It is preferred to use a mixture of gums. It has been found that the use of a particular mixture of gums is greatly preferred to provide the highest level of stability. In this connection, it is preferred to use a mixture of sodium alginate, carboxymethylcellulose in the sodium salt form and carrageenan. Preferably, the mixture of gums contains sodium alginate at a level of 50 to 80 weight percent, sodium carboxymethylcellulose at a level of 10 to 30 weight percent and carrageenan at a level of 10 to 30 weight percent. The stabilizing agents are used in the milk shake at a level of from 0.5 to 0.10 weight percent, preferably from 0.06 to 0.08 weight percent.

The emulsifier can be any monoester normally used as an emulsifier in the preparation of frozen desserts. Particularly useful are the monoester emulsifiers identified as propylene glycol monostearate and glycerol monostearate. It should be understood that the reference to propylene glycol monostearate and glyceryl monostearate is to the highly distilled commercial products which contain at least 90 percent of the monoester. Also useful as an emulsifier in the present invention are mixtures of propylene glycol monostearate and glyceryl monostearate stabilized in the alpha crystalline form in accordance with the teachings of United States Patent Nos. 3,453,116 and 3,673,106.

A particularly preferred emulsifier for use in the milk shakes of the invention is propylene glycol monostearate. It has been found that, particularly for chocolate flavored milk shakes, propylene glycol monostearate enhances the ability of the milk shake to prevent syneresis upon thawing and to prevent separation of chocolate color during the thawing cycle. Moreover, it has been determined that propylene glycol monostearate provides an emulsion which is more compatible with the colloid system (protein-gum stabilizers) of the invention. This enhanced compatibility results in ice retention, slower melting and more even melting.

In the method of manufacture of the frozen milk shake, whole milk, imitation milk or filled milk, is added to a jacketed kettle equipped with agitating means. Any remaining portion of dry sugar which is to be used is added to the kettle. The remaining non-volatile fluid ingredients, including the polyhydric freezing point depressant, are added to the kettle and the mix is pasteurized under suitable time temperature conditions. A suitable condition for pasteurization is to heat the mix to 71°C for 30 minutes. After pasteurization, the mix is maintained at a temperature of from 60°C to 82°C until the mix is homogenized.

It is sometimes preferred to hydrate the emulsifier prior to adding the emulsifier to the remaining ingredients. In this connection, the emulsifier is heated to a temperature sufficient to melt the emulsifier and hot water is thereafter added to the emulsifier in a jacketed mixing kettle. The hydrated emulsifier is then fed to the main mixing kettle by means of a metering pump. Salt and a vitamin-mineral premix, if used, are then added to the mix in the kettle.

The remaining dry ingredients including, the stabilizing agent and a portion of any dry sugar used, are mixed with non-volatile dry, powdered, flavoring materials and are combined with the mix in the main kettle.

While the mix is maintained at an elevated temperature of from 60°C—82°C the mix is pumped in a closed loop to thoroughly disperse all of the ingredients in the mix. Thereafter the mix is homogenized in a single stage at a pressure of from 500 to 2,000 psig.

The mix is then preferably pre-cooled to a temperature in the range of 4°C—16°C prior to whipping and cooling the mix. The pre-cooling is desirable to lessen the cooling load on the heat exchanger used for dynamic cooling. Just prior to introducing the pre-cooled mix to the heat exchanger, any volatile flavoring materials to be used are added.

The mix is then dynamically cooled in the heat exchanger to a temperature of less than −7°C while, to effect whipping thereof, a gas is injected into the mix at a level sufficient to generate from 50 to 100 percent overrun. The term "dynamic cooling" refers to cooling conditions such that the product is agitated during the cooling step. Any suitable heat exchanger can be used. The heat exchanger is preferably a scraped wall heat exchanger provided with an inlet whereby an inert gas can be injected into the mix as it is being cooled. A conventional ice cream freezer is

suitable for dynamic cooling of the mix. In this connection, it is not usual to lower the temperature of ice cream mixes and other related frozen dessert products to a temperature less than $-5°C$ by use of an ice cream freezer.

In the method of the present invention, it is desirable that less than 80 percent of the water present in the milk shake mix be frozen during passage of the milk shake mix through the freezer. Preferably, from 55 percent to 80 percent of the water is frozen during passage of the milk shake mix through the freezer.

It is known that fast freezing of ice cream mixes under dynamic conditions induce the formation of small ice crystals which is a prerequisite for a smooth textured ice cream. However, it is not the intention of the fast cooling step under dynamic conditions of the present invention to provide small ice crystals. In fact, it is preferred that a relatively small portion of the water of the milk shake mix be frozen during the cooling step in the ice cream freezer. The melt down characteristics of the ice cream and the melt down characteristics of the milk shake of the present invention are totally different. Furthermore, subsequent freezing of the milk shake of the present invention after the initial dynamic cooling step results in a product which upon subsequent thawing has the desired characteristics of a conventional milk shake. There is no similarity between thawed ice cream and conventional milk shake. It is believed that the ice crystal structure of ice cream and the frozen milk shake of the present invention are entirely different. The use of the polyhydric freezing point depressant in the milk shake mix of the present invention permits the use of low dynamic cooling temperatures without attaining a significant freezing of the water present in the milk shake mix during the dynamic cooling step.

The following Examples illustrate various features of the present invention.

Example 1.

A chocolate milk shake mix having the following ingredients at the indicated levels was prepared:

Ingredient		*Weight percent*
Homogenized Whole Milk		72.6
Sweetened Condensed Whole Milk (Butter fat 8.5%, Non-Fat Milk Solids 20%, Water 29.5%, Sucrose 42%)		2.6
Cream (about 38% butterfat)		3.0
Glycerol		7.6
Dextrose		7.1
Emulsifier (Hydrated)		3.9
Water	3.5	
PGMS	.14	
Glycerol Monostreate	.18	
Sodium Stearoyl 2-lactylate	.08	
Stabilizers		.07
Sodium alginate	.05%	
Carboxy methyl cellulose	.01%	
Carrageenan	.01%	
Cocoa		2.4
Vitamin-Mineral Mix		.23
Malt Powder		.20
Salt		.16
Artificial Flavors		.11
Water		.10

The homogenized whole milk at a temperature of 17°C is added to a jacketed kettle equipped with scraper blades. The milk is heated to a temperature of (46°—49°C) with agitation and two thirds of the dextrose is added. The cocoa is slowly added and is dispersed over a 15 minute hold period. The sweetened condensed whole milk is added slowly with agitation and the temperature of the mixture in the kettle is allowed to rise to 54—57°C. The glycerol is then added followed by addition of the cream.

In a separate jacketed, scraper equipped kettle, the emulsifiers are hydrated. The propylene glycol monostearate (PGMS), glycerol monostearate (GMS) and sodium stearoyl - 2 - lactylate are blended. The blend is slowly added to hot water (49°C) in the kettle with agitation. The mixture is heated to 77°C and held for 15 minutes with agitation. The emulsifier mixture is then slowly cooled with agitation to a temperature of 15—21°C. After cooling, the hydrated emulsifier may be held for daily use.

An amount of the hydrated emulsifier sufficient to provide the indicated level of emulsifier is added to the batch in the first-mentioned kettle with agitation.

In a separate blender, one sixth of the dextrose, sodium alginate, carboxymethyl cellulose, carrageenan and malt powder are blended. This dry blend is added to the heated (54°C) batch from the kettle by means of a powder funnel system with recirculation and agitation. Recirculation is continued until the dry ingredients are completely dispersed. Thereafter, the salt is added and the temperature of the batch in the kettle is raised to (71°C) with agitation. The batch is held in the kettle

at 71°C for 30 minutes to pasteurize the batch.

Five minutes after pasteurization is completed, the vitamin-mineral mixture is added to the batch. The vitamin-mineral mixture is combined with one sixth of the dextrose which serves as a carrier and insures good dispersion.

After pasteurization, the batch is homogenized at 1,000—1,500 psig, in a single stage, at a minimum temperature of 65°C to provide a milk shake mix. The homogenized milk shake mix is cooled to a temperature of 10°—16°C. A liquid mixture of the artificial flavors and water is prepared. Just prior to dynamic cooling of the milk shake mix, the liquid mixture of artificial flavors is added to the milk shake mix.

The milk shake mix is introduced into a conventional ice cream freezer at a temperature of 10°C. During passage of the milk shake mix through the freezer, the temperature of the mix is reduced to −10°C and air is injected into the milk shape mix at a level sufficient to provide 75 percent overrun. At the time of exiting from the dynamic cooling step 40—60 percent of the water present in the milk shake mix is frozen. 260 ml samples of the milk shake mix are stored in a freezer at a temperature of −29°C for a period of 1—2 days. At this temperature 100 percent of the water in the milk shake is frozen.

Samples of the milk shake are removed from the freezer and stored for 30 days at −12.0°C after which they are equilibrated at 21°C for 24 hours to determine phase separation (stability). Containers of the samples were opened and the extent of syneresis and color separation are measured. The syneresis as determined by the extent of an aqueous layer which formed is 113 ml (43.5 percent). The samples also demonstrated a high degree of color separation. The percentage of unmelted ice as a function of thaw-time was zero at 2 hours.

Example II.

A chocolate milk shake mix was prepared in accordance with the formulation and method of Example I with the exception that PGMS was used as the sole emulsifier. The PGMS was added directly to the batch in the kettle prior to pasteurization heat treatment of the batch.

260 ml samples of the milk shake are removed from a freezer (−29°C) and stored for 30 days at (−12°C), after which they are equilibrated at (21°C) for 24 hours to determine phase separation. The syneresis as determined by the extent of free water is 99 ml (38 percent). These samples indicated absolutely no degree of color change. The percentage of unmelted ice as a function of thaw-time was zero at 3.5 hours.

WHAT WE CLAIM IS:—

1. A method for making a frozen product comprising the steps of preparing a mix containing fat, disaccharide sugar, monosaccharide sugar, a stabilizer, an emulsifier and a polyhydric alcohol freezing point depressant, said freezing point depressant being present at a level sufficient to establish an initial freezing point in said mix of less than −4°C, pasteurizing said mix, homogenizing said mix, dynamically cooling said mix to a temperature of less than −7°C, injecting gas in said mix during said cooling step so as to whip the mix and to provide a product having from 50 to 100 percent overrun and freezing said whipped, cooled mix to provide a frozen product which upon subsequent thawing has the characteristics of a milk shake.

2. A method in accordance with claim 1, wherein said freezing point depressant is selected from glycerol and propylene glycol.

3. A method in accordance with claim 1 or 2, wherein the components of said mix are present at a level sufficient to provide a product having protein at a level of 2.4—3.4 weight percent, fat at a level of 3.5—5.0 weight percent, disaccharide sugar at a level of 4.0—6.0 weight percent, monosaccharide sugar at a level of 5.0—9.0 weight percent and water at a level of 66—77 weight percent.

4. A method in accordance with claim 3, wherein the weight ratio of monosaccharide sugar to disaccharide sugar is within the range of 1.2:1 to 1.6:1.

5. A method in accordance with any preceding claim, wherein said emulsifier is a monoester selected from propylene glycol monostearate and glycerol monostearate.

6. A method in accordance with any preceding claim, wherein said stabilizer is selected from carboxymethylcellulose in the sodium salt form, carrageenan, sodium alginate, propylene glycol alginate, locust bean gum, guar gum and mixtures thereof.

7. A method in accordance with claim 6, wherein said stabilizer is a mixture of 50 to 80 weight percent of sodium alginate, 10 to 30 weight percent of carboxymethylcellulose in the sodium salt form and 10 to 30 weight percent of carrageenan.

8. A method as claimed in claim 1, substantially as described herein in any of the Examples.

9. A frozen product made by a method as claimed in any preceding claim.